

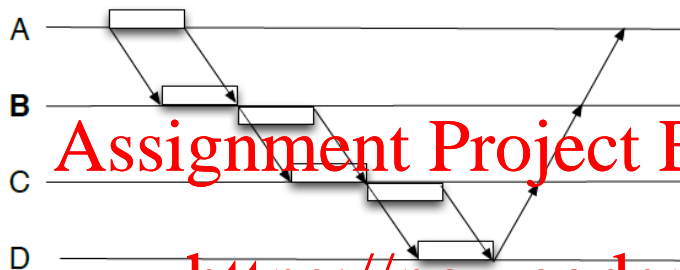
COMP 5416 Week 5

Exercise 1 Stop-and-Wait ARQ vs. Go-Back-N ARQ

In the following network, node A transmits packets that pass through B and C, and arrive at the destination D. The bit rate of all links is $R = 1$ Mbit/sec. The maximum packet size in the network is 500 Bytes. Ignore the header size. The one-way propagation delay on each link is 4msec.



(1) How long does it take to transmit a file of size 40,000 Bytes if A and D use Stop-and-Wait ARQ? Assume that there is no error in transmission in the network, and the size of ACK packets is negligible.



$$N = 40000/500 = 80 \text{ packets}$$

$$RTT = 6 * \text{prop_delay} + 3 * T = 24 + 12 = 36 \text{ msec}$$

$$\text{Total delay} = 80 * 36 = 2.88 \text{ sec}$$

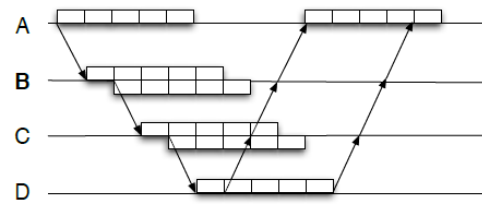
(2) How long does it take to transmit a file of size 40,000 Bytes if A and D use the Go-Back-N ARQ and B and C are Store-and-Forward? Assume that there is no error in transmission in the network, and the size of ACK packets is negligible

$$\begin{aligned}
 \text{RTT} &= 3T + 6 * \text{prop_delay} \\
 &= 3 * 4 + 6 * 4 \\
 &= 36 \text{ msec}
 \end{aligned}$$

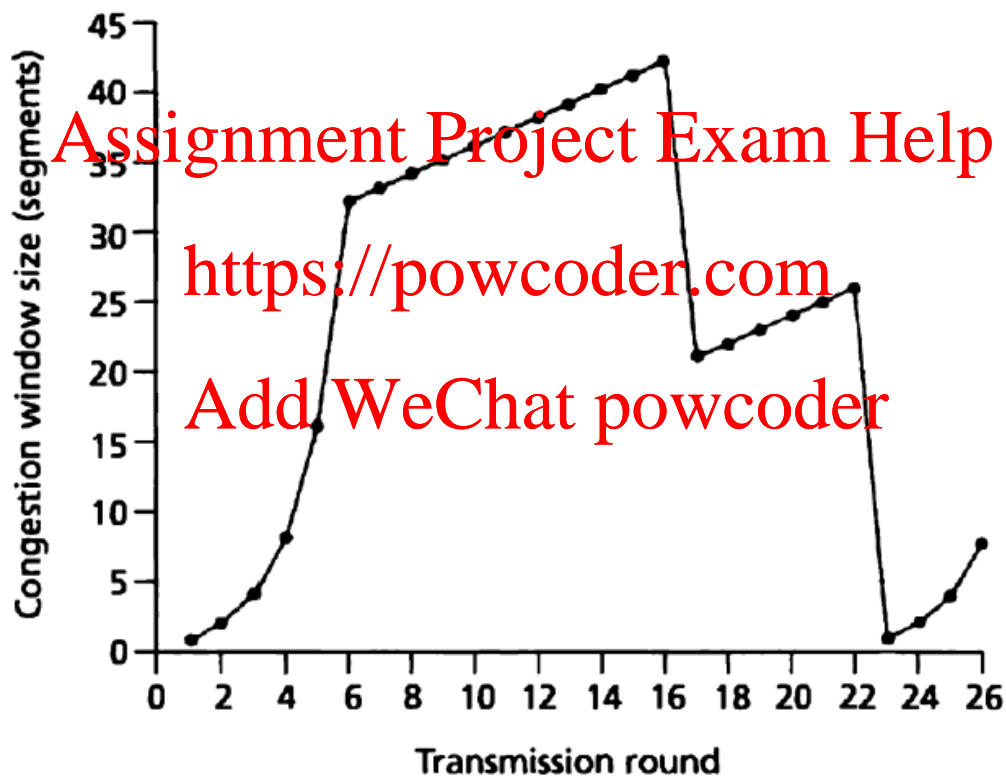
$$\text{no of batches} = 80 / 5 = 16$$

$$\begin{aligned}
 \text{Total delay} &= 16 * 36 + 4T \\
 &= 592 \text{ msec}
 \end{aligned}$$

The ACK for the last four packets in the last window = 4 T



Exercise 2: Congestion Control



Consider the above figure. Assuming TCP Reno is the protocol experiencing the behavior shown above, answer the following questions. In all cases, you should provide a short discussion justifying your answer.

- Identify the intervals of time when TCP slow start is operating. 1,2,3,4,5,23,24,25,26
- Identify the intervals of time when TCP congestion avoidance is operating. 6--22
- After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout? triple duplicate ACK
- After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout? timeout
- What is the initial value of ssthresh at the first transmission round? 32

- f. What is the value of ssthresh at the 18th transmission round? 21
- g. What is the value of ssthresh at the 24th transmission round? 13
- h. During what transmission round is the 70th segment sent?
7th round (first 6 rounds $1+2+4+8+16+32=63$, 7 round 33)
- i. Assuming a packet loss is detected after the 26th round by the receipt of a triple duplicate ACK, what will be the values of the congestion window? 7 (but will become 4 if newACK is received)
- j. Suppose TCP Tahoe is used (instead of TCP Reno), and assume that triple duplicate ACKs are received at the 16th round. What are the ssthresh and the congestion window size at the 19th round? ssthresh=21. 17:1, 18:2 19:4
- k. Again suppose TCP Tahoe is used, and there is a timeout event at 22nd round. How many packets have been sent out from 17th round till 22nd round, inclusive?

	17	18	19	20	21	22	sum
cwnd	1	2	4	8	16	21	52
ssthresh	21	21	21	21	21	21	

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